DEVON AREA
INTERNAL REPORT

ENVIRONMENT AGENCY

Investigation into the 1999 Failure of the European Community Bathing Waters Directive at Beer Beach

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EXECUTIVE SUMMARY

Beer Beach failed to reach the imperative standard for faecal coliforms (FC) in 1994 and 1999. Guideline bathing water standards have not been achieved in 1992, 93, 95, 97, 98 and 2000.

Analysis of historic European Community Bathing Waters Directive (ECBWD) data shows a significant correlation between rainfall and tide with the failures. The data show a correlation between the state of tide and the salinity of the bathing water samples. The samples taken around high water have a higher salinity than the samples around low water. It was also found that samples taken during wet weather showed a trend toward increased FC.

Beer Stream is the freshwater input that is associated with Beer Beach, it was first sampled with the bathing water in 1995. Beer stream discharges via a pipe onto the fore shore of Beer Beach, approximately 100m to the west of the sampling line. The Axe Estuary and Beer Head outfall also have potential to impact upon the bathing water quality. Beer Head outfall, which currently discharges untreated sewage, is to be upgraded to receive secondary treatment under Asset Management Plan III; this improvement is due by March 2002.

Catchment investigation highlighted contamination in Beer Stream during wet weather. Beer Stream issues on the edge of Bovey Lane bridle path, the path is popular with dog walkers. Run-off from the path mixes with the stream, this run-off was found to be grossly contaminated.

Further run-off from agricultural land drains to Beer Stream. Run-off from pig ranching was attributed to the failure in 1999, the pigs were moved following the failure. Run-off was seen during the investigation to be causing surface water flooding on the main road into Beer.

Beer combined sewer overflow is located at the fish quay and discharges to Beer Stream, it is not believed to pose a threat to the bathing water. No spills were found during the wet weather surveys.

We recommend:

- The control of pig ranching; not allowing ranching in the Beer Stream catchment
- Dog-waste collection facilities are placed at the entrance to Bovey Lane
- Consider diverting Beer Stream to Beer Head short sea outfall

Investigation into the 1999 Failure of the European Community Bathing Waters Directive at Beer Beach

1.0 Catchment Description

Beer beach (sample point no. 70214515) is designated under the European Community Bathing Waters Directive (ECBWD) number 76/160/EEC, see Appendix 1 for standards. In the proximity of Beer Beach there are two main freshwater inputs (see Figure 1):

- Beer Stream which discharges via an outfall pipe
- River Axe to the east of Beer

Beer has a steep pebbly beach popular with tourists, it is also a working fishing village. Beer Stream runs through the town centre and discharges via an outfall pipe just offshore approximately 100m west of the bathing beach sampling line.

Beer Stream issues at Bovey Lane bore hole. It flows down the edge of the bridle path, then through the town to the beach via a number of culverts and open sections. The stream takes all surface water runoff from the town centre and surrounding agricultural land. The stream is sampled with the bathing water via a manhole on the fish quay.

Beer town centre has experienced flooding caused when runoff from surrounding farmland and the town has overloaded the stream channel and culverts.

In 1998 SWWL undertook work on Beer Combined Sewer Overflow (CSO). The CSO discharge is via the stream outfall, an attenuation tank was constructed and the CSO re-engineered. We considered deploying event-monitoring equipment to the overflow but the nature of the structure and the Health & Safety implications prevented us from doing so. It was assumed that any CSO discharges during the surveys would be evident in the sample results.

An investigation into the failure of the Bathing Waters Directive at Beer in 1994 is kept on file; report number: DEV/WQ/15/96.

There is a continuous discharge near the bathing water, Beer Head outfall discharges crude sewage at NGR SY 2268 8783, see figure 1.

The ECBWD samples are collected from: 1st May (two weeks before the start of the bathing season) to 30th September; on the same day a sample is taken from Beer Stream (sample point no.70210602). Beer Stream has been sampled with the bathing water since 1995.

1.1 Objectives

Beer Beach failed to meet the Imperative standard for faecal coliforms (FC) in 1999, see table 1 for compliance history. Regional Tidal Water Quality (RTWQ) raised concerns that Beer Stream, Beer Head Outfall and Beer CSO potentially impact upon the water quality of the bathing beach.

The purpose of this investigation is to:

- Determine the probable cause of the 1999 ECBWD failure at Beer Beach
- Identify any areas of concern that may contribute to poor water quality at the beach
- Recommend actions that will improve the water quality at the beach to reduce the risk of further exceedences

1.2 Project Team

Project Manager – Trevor Cronin
Project Leader & Author – Stuart Hunter

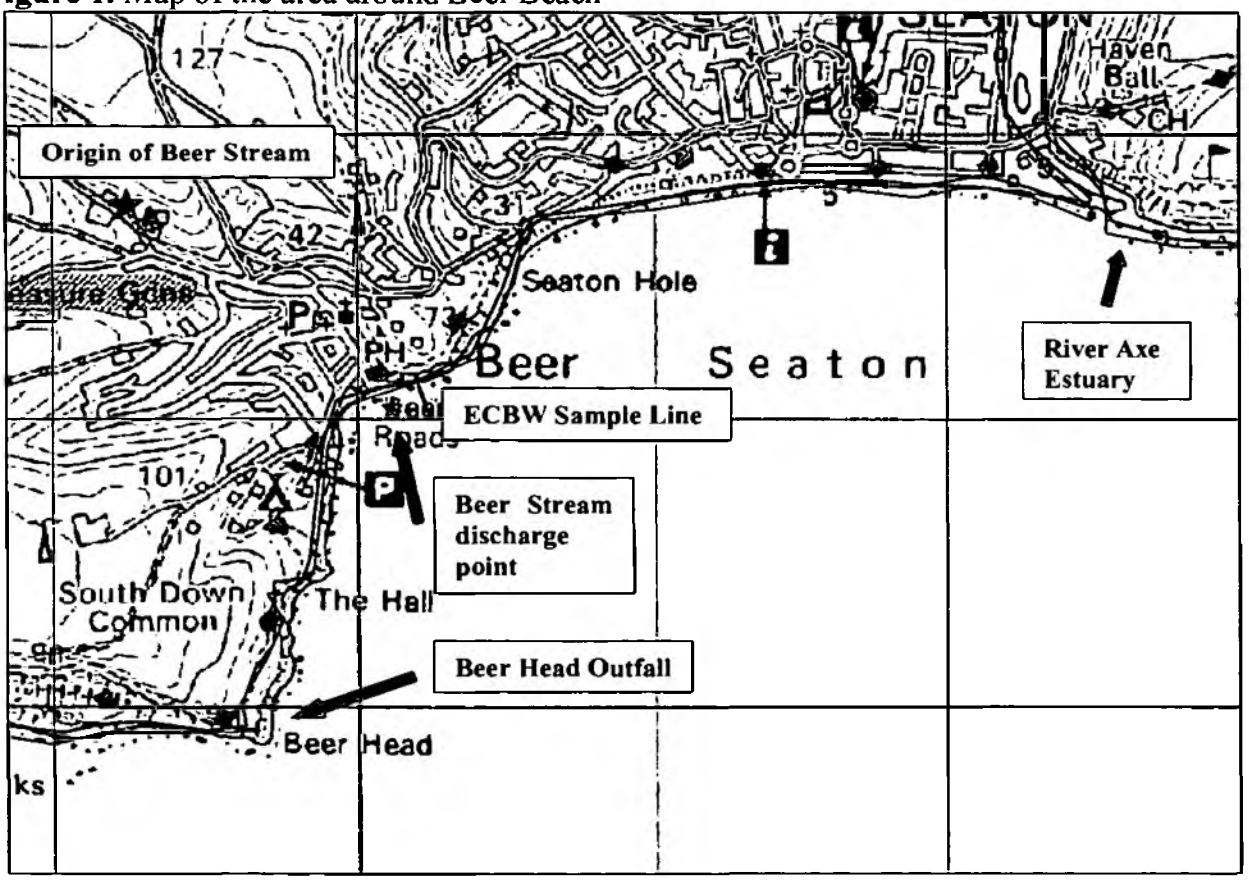
2.0 Catchment History

Beer Beach failed in 1994 with two samples exceeding the imperative standard of faecal coliforms, one of these samples also exceeded total coliforms. An investigation into this failure was undertaken and is kept on file, report number: DEV/WQ/15/96. There have also been single sample exceedences in a season on 2 occasions, faecal and total coliforms in 1991 and faecal coliforms in 1992.

2.1 Location

A site map of the area showing relative positions of Beer Beach, Beer Stream, Beer Head outfall and surrounding land is presented in Figure 1. More detailed maps showing survey sample points and the location of Beer CSO are shown in Figures 2 & 3.

Figure 1. Map of the area around Beer Beach



2.2 Compliance

The compliance history of Beer Beach with the Bathing Water Directive for the period 1990 to 2000 is given below in Table 1.

Table 1. Compliance history of Beer Beach

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Compliance	G	G	I	I	F	I	G	I	I	F	I
No. of samples	20	20	22	20	20	20	20	20	20	21	20
No. fail FC 'I'	0	1	1	0	2	0	0	0	0	2	0
No. fail TC 'I'	0	1	0	0	1	0	0	0	0	0	0
No. fail FC 'G'	4	3	5	8	8	4	3	6	4	10	4
No. fail TC 'G'	2	3	2	3	5	1	0	4	3	6	0
No. fail FS 'G'	1	1	2	2	4	3	0	4	3	6	4
FC Geomean	30.19	39.31	36.27	48.93	81.03	39.23	21.72	52.18	34.02	71.55	39.38

Compliance to: I = imperative, G = Guideline, F = Fail
FC= Faecal Coliforms, TC = Total Coliforms, FS = Faecal Streptococci
NB Geomean calculated data sets with all results less than 10 as 10 to take variable lower detection limit into account

2.3 Regional Bathing Water Database

This database identifies: compliance history; factors affecting water quality; actions already taken to improve water quality; planned investigations; planned investment and predicted changes in water quality. The information relating to Beer Beach is presented in Appendix 2.

3.0 Method

The investigation has been split into several parts:

- a biodiversity search of the area
- a risk assessment
- historic data analysis
- survey work to collect field data

3.1 Biodiversity

A map of the investigation area and a description of the nature of the investigation were supplied to the Conservation Team. They determine if our actions raise any biodiversity issues, and inform us of conservation designated sites we should be aware of.

3.2 Risk Assessment

An initial site visit was made on 22nd May 2000. During this visit the catchment was visibly inspected for any signs of pollution and Beer Stream was walked from the discharge point on the beach to its source in Bovey Lane. A risk assessment of the site was completed, see Appendix 3.

3.3 Historic Data Analysis

Data collected during the period 1990 – 1999 from Beer Beach ECBWD site was analysed in order to reveal any trends. Correlation between exceeded samples, wind direction, state of tide, rainfall and samples from associated freshwater inputs were all investigated.

3.4 Field Work

The field surveys firstly looked at possible impacts on water quality highlighted in previous investigations. Secondly the discharges and areas of concern highlighted at the start of this investigation. Finally any areas of concern found during the investigation.

An initial site visit was made on 22nd May 2000, during this visit a visual inspection of the catchment was made. Four samples of the stream were taken (in dry weather). Three from a manhole above the beach, see figure 3, this manhole is used to sample Beer Stream when bathing water samples are taken. The fourth sample was from the stream in the town before it enters the final culvert.

3.4.1 Inspection of flows through culverts at the Fish Quay

On 31st May 2000 a survey of flows was conducted in the fish quay area. The stream separates into two culverts above the fish quay. The purpose of the survey was to ascertain which culvert the CSO discharges into and the location of relevant manholes to gain access to the stream. Site plans were supplied by SWWL and fluoresceine dye was used to trace flows.

3.4.2 Dry Weather Survey 18th July 2000

A dry weather survey of Beer Stream took place on 18th July 2000, there were eight sample points, see figure 2. Sample point 1 is the ECBWD sample point, the remaining sample points were positioned on the stream. The sample points were chosen throughout the catchment in an attempt to highlight any contamination to the stream. There were three sampling runs, the first at 0700, the second at 1230 and third at 1830. These times were chosen to coincide with peak use of the sewerage system to show evidence of any misconnection to the stream of domestic or commercial property. Site 5 is a pipe discharge to the stream and site 8 is the first open access to the stream below Bovey Lane bore hole. All samples were analysed for Faecal and Total Coliforms and Faecal Streptococci.

3.4.3 Wet Weather Run 18th August 2000

A wet weather run took place on 18th August in heavy rain. An extra site was sampled, this was runoff from the bridle path on Bovey Lane. The flow of runoff was approximately the same as that in the stream, the runoff mixed with the stream approximately 20cm downstream of where it first enters an open channel, see figure 4 plate 2. Only one wet weather run was undertaken because the conditions needed were only achieved in heavy rainfall, when surface water runoff was taking place; after the downpour the rain eased.

3.4.4 Wet Weather Run 21st September 2000

A second wet run took place on 21st September, this run was in light rain. The sea was too rough to safely collect a sample at site 1. There was no flow at site 8 and there was no runoff from the bridle path. Again only one run was collected due to easing of the rain.

3.4.5 Wet Weather Run 9th October 2000

A third wet run took place on 9th October in heavy rain. The sea was too rough to safely collect a sample at site 1. There was flow at site 8 and runoff from the bridle path.

4.0 Results

4.1 Biodiversity

Devon Area Conservation Team highlighted the designated sites of conservation interest in the Beer area, these are:

- Beer Quarries – cSAC/SSSI (bat interest)
- East Devon Heritage Coast/ANOB (landscape designation)
- Sidmouth to West Bay – cSAC
- Bovey Lane Quarries – County Wildlife Site
- Quarry Lane – Special Road Verge

See appendix 4 for full report including map from the Conservation Team.

4.2 Risk Assessment

An on site risk assessment was carried out. One specific risk: steep loose pebbly beach was identified, other than those normally associated with fieldwork of this nature were raised (see Appendix 3).

4.3 Historic Data Analysis

A summary of data associated with the exceeding bathing water samples is presented in **Table 2.**

Table 2. Summary of the ECBWD samples which exceeded the I standard between 1990 & 2000

Date	Time of Sample	FC no/100ml	Wind speed	Wind dir.	Rainfall at time of sample				State of tide	Sal g/kg
					-3 days	-2 days	-1 day	On day		
24-Jun-91	11:25	6600	2	SW	0.6	10	35.5	8	-5.4	29.2
11-Aug-92	12:28	3420	2	W	0	0.1	1.2	19.7	-4.7	33.1
24-May-94	11:50	3100	0	SE	18.7	2	0.1	18.4	5.3	28.6
26-Jul-94	12:15	3000	3	S	0	0	0	3.7	2.3	34.4
17-Aug-99	11:32	5500	4	SW	0	0	10.2	11.7	0.5	34.8
23-Sep-99	11:50	3440	5	SW	9.4	6.8	10.2	9.7	5.8	32.7

4.3.1 Rainfall

All the results for FC counts over the period 1990 – 1999 were correlated against rainfall on the day of the sample and the previous day. A positive correlation was found between rainfall in the catchment and faecal coliform concentrations. Figure 5 shows the chart, whilst there is a lot of scatter there is clear trend for higher concentrations at higher rainfall.

The rainfall day used by the Environment Agency begins at 0900 and runs to 0900 the following day. The exceeded bathing water samples were taken early in the day (see table 2), thus rainfall recorded on the day of the sample has a high probability of falling after the sample was collected.

4.3.2 Wind Direction

At the time of the six imperative exceedences, wind directions were from the south-east, south, south-west (3 samples) and west. Wind speeds ranged from 0 to 5 on the Beaufort scale. On the date of the greatest exceeded value (FC 6600 no/100ml on 08 September 1999) the wind direction was south-west with a wind speed of 2. A chart showing log FC numbers from 1990 to 1999 plotted against wind direction can be seen in figure 6.

4.3.3 State of Tide and Salinity

The salinity of the bathing water samples was found to be correlated to the state of tide. When the tidal cycle was plotted against the salinity of the samples a clear trend is visible, see figure 7. The samples with the highest salinity were taken around high water, the salinity decreases as the tide drops. The lowest salinities were found at low water +/- 1 hour. Of the six samples that exceeded the imperative standards between 1990 and 1999, four were taken around low water.

The samples that exceeded in 1999 had salinity concentrations of 34.8 and 32.7g/kg. Atlantic seawater has a salinity of 35 g/kg. The sample with the salinity of 34.8 was taken approximately half an hour after high water, the other sample (32.7 g/kg) was taken approximately 10 minutes before low water.

4.3.4 Actual Verses Predicted Faecal Coliform numbers

An indication of the origin of faecal coliform contamination can be made by plotting predicted FC concentrations at the bathing water site against the actual concentration in the bathing water samples. This is done using FC and salinity results from Beer Stream samples and the actual bathing water sample results. Figure 8 shows the predicted (or estimated) faecal coliform concentration. On the chart:

Area A represents samples whose FC concentrations were substantially lower than we would have predicted, this may be due to bacterial decay in the bathing water which will move points above the yellow line.

Area B represents samples whose FC concentrations that were of a similar order to those we would have predicted and indicate that Beer Stream was determining water quality at the beach site.

Area C represents samples whose FC concentrations were higher than those predicted and indicate that other sources were responsible, possibly a marine source.

The two points highlighted with the date, to the right of the vertical line are the exceedences. Both points are near to area B and are considered to be due to contamination by Beer Stream.

Beer Stream was first sampled with the bathing water in 1995. The only two imperative exceedences since then were in 1999. These two samples fall in the area on the chart where the actual sample results were found to be slightly higher than the predicted result from the Beer Stream sample.

4.3.5 Associated Freshwater inputs

When bathing water samples are taken, samples are also taken from associated freshwater inputs. In the case of Beer this is Beer Stream. The River Axe Estuary also discharges near to the bathing water; this is sampled as it is the associated freshwater input to Seaton bathing water. The results of these samples can be seen in table 3.

Table 3. Samples taken in the mouth of the Axe Estuary (70210103) on the days of imperative exceedences at Beer Beach.

Sample Date	Sample Time	Total Coliforms No. per 100ml	Faecal Coliforms No. per 100ml	Faecal Streptococci No. per 100ml	Salinity g/kg
24-Jun-91	10:45	172000	49000	11100	1
11-Aug-92	11:47	140000	76000	13000	18
24-May-94	11:20	37000	17000	5900	9.37
26-Jul-94	11:50	900	290	40	34.1
17-Aug-99	11:10	No TC samples	250	108	34.5
23-Sep-99	11:30	After 1997	8636	2200	1

Using the Tidal Stream Atlas and observations made, by Devon Area Investigations Team, during the Seaton Survey 2000. We can predict that the tidal currents are most likely to carry the discharge from the Axe Estuary towards Beer Bathing Waters at HW1+3 to HW2 -3, see ref 4 and 5. The results of the survey also showed that tracer bacteria (*Bacilus globiggi*) were found at the most westerly sample point at the end of Seaton Beach nearest to Beer.

4.4 Field Surveys

A number of samples were taken throughout the investigation. Figures 2 & 3 are maps with all sample points highlighted.

The results from the four samples collected during the initial site visit (dry weather conditions) can be seen in table 4. Figure 3 shows a diagrammatic representation of the fish quay area and flows through it.

Table 4. Sample from site visit 22nd May

Date of Sample	Time of Sample	Location	T. Coliforms no. per 100ml	F. Coliforms no. per 100ml	F. Streps no. per 100ml
22/05/00	12:19	In MH: Culverted Prtn	2400	108	153
22/05/00	12:20	In MH: Open prtn	1273	198	189
22/05/00	12:21	In MH: Prtn from SO	420	126	310
22/05/00	12:25	Beer Stream @ Site 2	500	63	230

4.4.1 Inspection of flows through culverts at the Fish Quay

The results from this can be seen in figure 3. The stream is split into two culverts at the end of Fore Street. One half flows to the east and is not visible again until it discharges into the sea, the other half flows to the west; first culverted then in an open channel then culverted to discharge in the sea. The west portion of flow has the potential to split when it leaves the open channel, during high flows not all enters the first culvert. The second culvert joins any discharge from the CSO.

All three flows converge in a manhole by the beach. This manhole is used by the Area Monitoring Team to sample Beer Stream, and is site 2 during this investigation.

4.4.2 Dry Weather Survey 18th July 2000

The results from the dry weather survey show a general increase in bacterial loading as the stream flows through the catchment. The most contaminated sample for FC was from site 6 at 0715: 470 FC per 100ml. Sample site 8 was the cleanest: all three samples were at the minimum detectable limit of <10 for all determinands. The three samples taken at site 1 (the ECBW sample point) all complied with the imperative standards for the Directive, however the results from the last run exceeded the guideline standards for faecal coliforms and faecal streptococci. The results for the survey can be seen in table 5.

Table 5. Dry weather survey results 18th July 2000

Date Sample Taken	Time of sample	Sample site	Total Coliforms no. per 100ml	Faecal Coliforms no. per 100ml	Faecal Streps no. per 100ml	Salinity ppt (site 1 & 2 only)
18/07/00	06:58	1 (ECBW)	18	18	18	33.1
18/07/00	07:02	2	1545	300	63	0.0
18/07/00	07:07	3	2800	200	54	
18/07/00	07:10	4	1727	280	27	
18/07/00	07:12	5 (pipe)	10 <	10 <	10 <	
18/07/00	07:15	6	1636	470	45	
18/07/00	07:16	7	210	36	10 <	
18/07/00	07:20	8	10 <	10 <	10 <	
18/07/00	12:25	1 (ECBW)	10 <	18	10 <	30.5
18/07/00	12:27	2	2500	320	180	0.0
18/07/00	12:40	3	660	200	81	
18/07/00	12:49	4	720	380	36	
18/07/00	12:52	5 (pipe)	126	63	10 <	
18/07/00	12:56	6	350	108	10 <	
18/07/00	12:58	7	171	36	45	
18/07/00	13:05	8	10 <	10 <	10 <	
18/07/00	18:39	1 (ECBW)	320	220	250	28.4
18/07/00	18:44	2	1364	160	144	0.5
18/07/00	18:57	3	1182	280	135	
18/07/00	18:58	4	1273	310	90	
18/07/00	19:02	5 (pipe)	18	10 <	10 <	
18/07/00	19:04	6	90	81	81	
18/07/00	19:09	7	126	36	27	
18/07/00	19:14	8	10 <	10 <	10 <	

4.4.3 Wet Weather Run 18th August 2000

The results from this run (table 6) show contamination of Beer Stream with faecal bacteria. All stream samples, except site 8, have counts of >100,000 per 100ml for all three determinands. The sample of runoff from the bridle path on Bovey Lane was also >100,000 per 100ml for the determinands. This is the upper detection limit for the samples without dilution by the laboratory. Site 5 which is a pipe discharge to the stream had a low count of faecal bacteria. Site 1 at the ECBW sample point had a FC count of 4,200 per 100ml, this is greater than the imperative standard of 2,000 per 100ml.

Table 6. Wet run survey results 18th August 2000

Determinand			3537	3703	3533	
Date Sample Taken	Time of sample	Sample site	Total Coliforms no. per 100ml	Faecal Coliforms no. per 100ml	Faecal Streps no. per 100ml	Salinity ppt (site 1 & 2 only)
18/08/00	11:18	1	12,000	4,200	2,100	33.7
18/08/00	11:24	2	>100,000	>100,000	>100,000	0.0
18/08/00	11:27	3	>100,000	>100,000	>100,000	
18/08/00	11:30	4	>100,000	>100,000	>100,000	
18/08/00	11:35	5	3,600	1,364	410	
18/08/00	11:36	6	>100,000	>100,000	>100,000	
18/08/00	11:39	7	>100,000	>100,000	>100,000	
18/08/00	11:42	8	340	320	153	
18/08/00	11:44	runoff from Bridle Path	>100,000	>100,000	>100,000	

4.4.4 Wet Weather Run 21st September 2000

The run on the 21st September was in light rain only, there was no runoff from the bridle path. There was also no flow at site 8, I spoke to an operator at the bore hole who told me that due to pumping of the bore hole flow would temporarily cease. The sea was too rough to sample site 1. The results from the stream (table 7) show contamination from faecal bacteria, the most contaminated sample for FC was at site 7 with 67,000 per 100ml followed by site 2 with 44,000 per 100ml.

Table 7. Wet run survey results 21st September 2000

Determinand			3537	3703	3533	
Date Sample Taken	Time of sample	Sample site	Total Coliforms no. per 100ml	Faecal Coliforms no. per 100ml	Faecal Streps no. per 100ml	Salinity ppt (site 1 & 2 only)
21/09/00	10:10	1	No sample too rough			
21/09/00	10:15	2	64,000	44,000	52,000	0.0
21/09/00	10:20	3	47,000	37,000	33,000	
21/09/00	10:22	4	37,000	25,000	14,545	
21/09/00	10:24	5	270	36	10	
21/09/00	10:26	6	80,000	24,000	20,000	
21/09/00	10:27	7	140,000	67,000	64,000	
21/09/00	10:30	8	No sample no flow			

4.4.5 Wet Weather Run 9th October 2000

The wet run on 9th October was in heavy rain. There was a lot of runoff from the bridle path and from surface water drains throughout the catchment. Site 1 was not sampled due to rough seas. The samples were diluted before analysis. As the results show (table 8) Beer Stream had very high levels of faecal contamination, at site 2 prior to discharge to the bathing waters the FC count was 510,000 per 100ml. The cleanest sample was site 5 with FC 330 per 100ml.

Table 8. Wet run survey results 9th October 2000

Determinand			3537	3703	3533	
Date Sample Taken	Time of sample	Sample site	Total Coliforms no. per 100ml	Faecal Coliforms no. per 100ml	Faecal Streps no. per 100ml	Salinity ppt (site 1 & 2 only)
09/10/00	11:39	1	No sample too rough			
09/10/00	11:40	2	1,000,000	510,000	330,000	0.0
09/10/00	11:42	3	1,090,000	690,000	340,000	
09/10/00	11:44	4	1,000,000	650,000	350,000	
09/10/00	11:45	5	400	330	81	
09/10/00	11:46	6	1,000,000	720,000	430,000	
09/10/00	11:48	7	370,000	250,000	170,000	
09/10/00	11:49	8	38,000	21,000	13,000	
09/10/00	11:51	runoff from Bridle Path	1,000,000	490,000	270,000	

5.0 Discussion

The investigation into the 1994 failure (ref. 1) of the Bathing Waters Directive at Beer Beach concluded that:

- Beer Stream could have been the source of bacteria that caused the failure of the bathing water in 1994
- Bacteriological levels found in Beer Stream during the investigation could lead to a exceedence in total and faecal coliforms
- Beer Stream can be highly contaminated on occasion

The investigation recommended that the monitoring of Beer Stream as part of the Bathing Water Directive continue.

5.1 Historical data analysis

Between the period 1990 to 2000, Beer Beach has failed to achieve the imperative standards for FC in 1994 and 1999. It has achieved imperative but failed the guideline standards for FC in 1992, 1993, 1995, 1997, 1998 and 2000. Guideline standards have been met in 1990, 1991 and 1996.
Analysis of historical data showed a trend between increasing rainfall and an increase in FC counts in the bathing water, this can be seen in figure 5. In 1999 the samples that exceeded

were both associated with rainfall. The first exceedence on the 17th August was during flooding of the town centre, 11.7mm were recorded on the 17th and 10.2 on the 16th. The second exceedence was on the 23rd September which had 9.7mm, the 22nd had 10.2mm.

Increased runoff due to lack of vegetation and soil compaction, combined with contamination with bacteria from pig faeces was thought to have contributed to these exceedences. It is believed the pigs were moved after the exceedence on 17th August but before the exceedence on the 23rd September. However, the fields were still bare at the time of the second exceedence.

Wind direction does show a correlation with FC concentrations in samples. As figure 6 shows, winds from the west and south show higher average FC counts. These increased counts are attributed to the wetter weather associated with these winds.

The salinity of the bathing water samples show a strong link to the tidal cycle as shown in figure 7. The samples taken near high water have a higher salinity than those taken around low water. Four of the exceeding samples were taken near low water and had low salinity's. Of the two exceedences at High water, the sample on 17th August 1999 was associated with flooding of the town and runoff from outdoor pig farming. The other on 26th July 1994 was not associated with heavy rain. If Beer Stream makes up the fresh water component of the bathing water samples, on days when the stream is contaminated the beach is more likely to fail around low tide.

The predicted faecal coliform concentration in the bathing water samples (calculated from Beer Stream faecal coliform results and salinities) are plotted against the actual sample result, see figure 8. The two 1999 exceedences show a higher concentration than predicted. This result is attributed to the 'foul first flush' effect where the initial flood of storm water is highly polluted and subsequent flow is more dilute.

In this scenario the stream would have discharged the first flush prior to the sample being taken. The bathing water sample however would be contaminated by the higher concentration of pollutant from the first flush. This phenomenon has been shown previously during wet weather surveys e.g. Holcombe Stream which is situated in a similar size catchment is also influenced by agricultural runoff comparable to Beer, ref 2.

5.2 Dry weather survey 18th July 2000

The results from the dry weather survey showed a general increase in FC loading through the catchment. This is not unusual. The level of contamination found in the samples is not considered to pose a threat to the bathing water.

5.3 Wet weather Surveys

Due to the problems of planning wet weather surveys in summer we decided to attempt a reactive sampling run when it was raining, rather than planning a whole day survey in advance. This technique allowed the sampler to wait until a downpour before commencing a run. Hopefully this enables samples to be taken when runoff from the land is greatest, and the probability of a CSO spill is greatest.

5.3.1 18th August 2000

The results show contamination of Beer Stream with faecal pollution indicator bacteria. The sample of the bathing water also shows contamination and fails to meet the Bathing Water Directive Standards. This survey shows that Beer Stream is uncontaminated when it issues from Bovey Lane borehole. The sample at site 8 has very low bacterial counts when compared to the runoff from the bridle path. The bridle path is approximately 1.5 km in length, it runs along the valley bottom and acts as a channel for runoff during heavy rainfall. It is popular with dog walkers and dog and horse faeces were visible throughout the length of the path.

Site 5, like site 8, had low bacteria counts compared to Beer Steam, however they were higher than in previous surveys. This is thought to be due to the high flow level in the stream, which made discrete samples of the discharge at sites 8 and 5 impossible. It is likely that the stream and runoff from the bridle path contaminated these samples (during collection).

5.3.2 21st September 2000

There was only light rain during this survey. There was no flow at site 8 from the Bovey Lane borehole and there was no runoff from the bridle path. There was flow at site 7 and this was found to be the most contaminated site. With the exception of site 7, the concentrations of bacteria increase through the catchment. This is as expected due to runoff from roads and pavements which contains faecal matter from dogs, cats and birds.

The sea was considered too rough to sample the bathing water. The FC count at site 2 was 44,000 per 100ml. With this data it is possible to estimate the potential FC numbers in the bathing water originating from Beer Stream. By plotting FC concentrations against the salinity of a bathing water sample, see figure 9, it shows that a sample during this survey with a salinity of 33.41 g/kg or less would be at risk of failing the Bathing Water Directive. This technique assumes:

- undiluted sea water has a salinity of 35 g/kg
- the fresh water portion of a bathing water sample originated entirely from Beer Stream
- there was no die-off of bacteria in the saline environment prior to sampling
- there were no pollution indicator bacteria present in the background seawater

5.3.3 9th October 2000

The samples collected during this survey were diluted prior to analysis as the results (table 8) show the stream samples were grossly contaminated. As in the previous surveys, sample points 8 and 5 were the least contaminated.

There was runoff from agricultural land flowing down the B3174, the road into Beer Town Centre (see fig.4 plate 1). There was also a lot of runoff from the bridle path. All this runoff drains into Beer Stream and ultimately into the bathing water.

This survey was outside of the bathing water season, but highlights the impact of heavy rainfall on Beer Stream. Five of the stream samples had total coliform counts of 1,000,000 or over. The lowest FC count in the stream (apart from site 8) was 250,000 at site 7. The other

samples ranged from 490,000 to 750,000. Unfortunately it was too rough to safely collect a sample of the bathing water. With this level of pollution it is likely that the bathing water would exceed, as demonstrated in figure 9.

The results show a decrease in results between sites 2 and 3. This indicates Beer CSO was not operating during the sampling run.

5.4 Planned Improvements at Beer

In Asset Management Plan III (AMP III) Beer Head outfall untreated sewage discharge is to receive secondary treatment this improvement is due by March 2002.

5.5 Other Concerns

The local fishermen often discard shells and other fish waste onto the beach. This practice was considered to pose a threat to water quality plus it attracted gulls, which may also contribute to bacteria concentrations in the bathing water. A memo dated 14/04/00 was sent from Devon Area Investigations to the area Environment Protection (East) Team Leader to recommend this practice be stopped.

Beer Head outfall discharges crude sewage. The pipe runs through a tunnel in the base of the cliff, manholes are present on the cliff path to inspect the tunnel. I spoke to SWWL about its construction and they informed me that a structural integrity survey took place in c.1990. Also that if there was any damage to the outfall pipe the leaking sewage would back up the tunnel and cause the CSO to discharge at the fish quay rather than leak directly to the bathing water.

6.0 Conclusions

1. Diffuse pollution is having a major impact on Beer's bathing water quality during wet weather. There are two main sources of this pollution:

- Runoff from Bovey Lane Bridle Path contaminated with faecal pollution. The path is popular with dog walkers and large amounts of faeces have been observed on the path. The runoff mixes with Beer Stream and discharges into the bathing water.

- Runoff from pig ranching in the Beer Stream catchment poses a threat to the bathing water quality at Beer.

Also, surface water flooding caused by runoff from agricultural land at Beer was seen on the B3174. Beer has had a flooding problem. There was flooding in the town during the bathing water exceedence on 17th August 1999.

The Rural Land Use Group based at Devon Area were consulted regarding the situation at Beer. A number of points were raised; the relocation of the pigs from the catchment would reduce the bacterial loading from agricultural runoff. Potential damage to the land caused by the pigs through compaction of the soil could lead to:

❖ Higher risk of flooding through increased runoff.

- ❖ Potential for any waste spread to the damaged land to be carried by runoff during rainfall and impact on the bathing water quality.

2. The integrity of Beer outfall is believed to be good, any defect in the outfall pipe would result in flooding of the outfall tunnel and operation of Beer CSO.

3. Beer Head outfall discharges crude sewage, this discharge contributes to bacterial loading of the bathing water. Planned improvements to the discharge under AMP III will benefit bathing water quality.

4. Any contaminated discharge from the River Axe could contribute to FC loading at Beer bathing water.

7.0 Recommendations

1. Pig ranching should be controlled, and stopped in the Beer Stream catchment (action already taken by area EPO after the first exceedence in 1999).
   Action: Environment Protection Officer

2. Dog waste bins and signs could be placed at the entrance to Bovey Lane to reduce the bacterial loading from dog faeces entering Beer Stream during a downpour.
   Action: Environment Protection Officer

4. Consider redirecting Beer Stream at the fish quay to the short sea outfall at Beer Head.
   Action: Environment Protection Officer

8.0 References

1. A Loxton. *An Investigation to find the cause of non-compliance with the E.C. Bathing Waters Directive at Beer Beach.* Devon Area Internal Report, DEV/WQ/15/96. March 1995.

2. Robin Pearson. *Holcombe Beach ECBW failure 1998.* Working file. Held in Devon Area Investigations Team office.

3. Environment Agency, 2000. *Local Environment Agency Plan, Axe & Lim Action Plan December 2000 to December 2005.*

4. Admiralty tidal stream atlas. *The English and Bristol Channels.* 1973 3rd edition. Hydrographic Office

5. Peter Rose. *Investigation into the Probable Cause of the 1999 failure of the EC Bathing Waters Directive at Seaton (Devon) Beach (70210103).* Devon Area Internal Report, DEV/EP/04/01, May 2001.

6. Environment Agency. *Environment Agency Seminar on Non-Compliant Bathing Water Investigations.* Held on 8th and 9th June 1999 at the Coventry Posthouse. Compiled by: D Lowthian, July 1999 Reference: 10141.

Figure 3

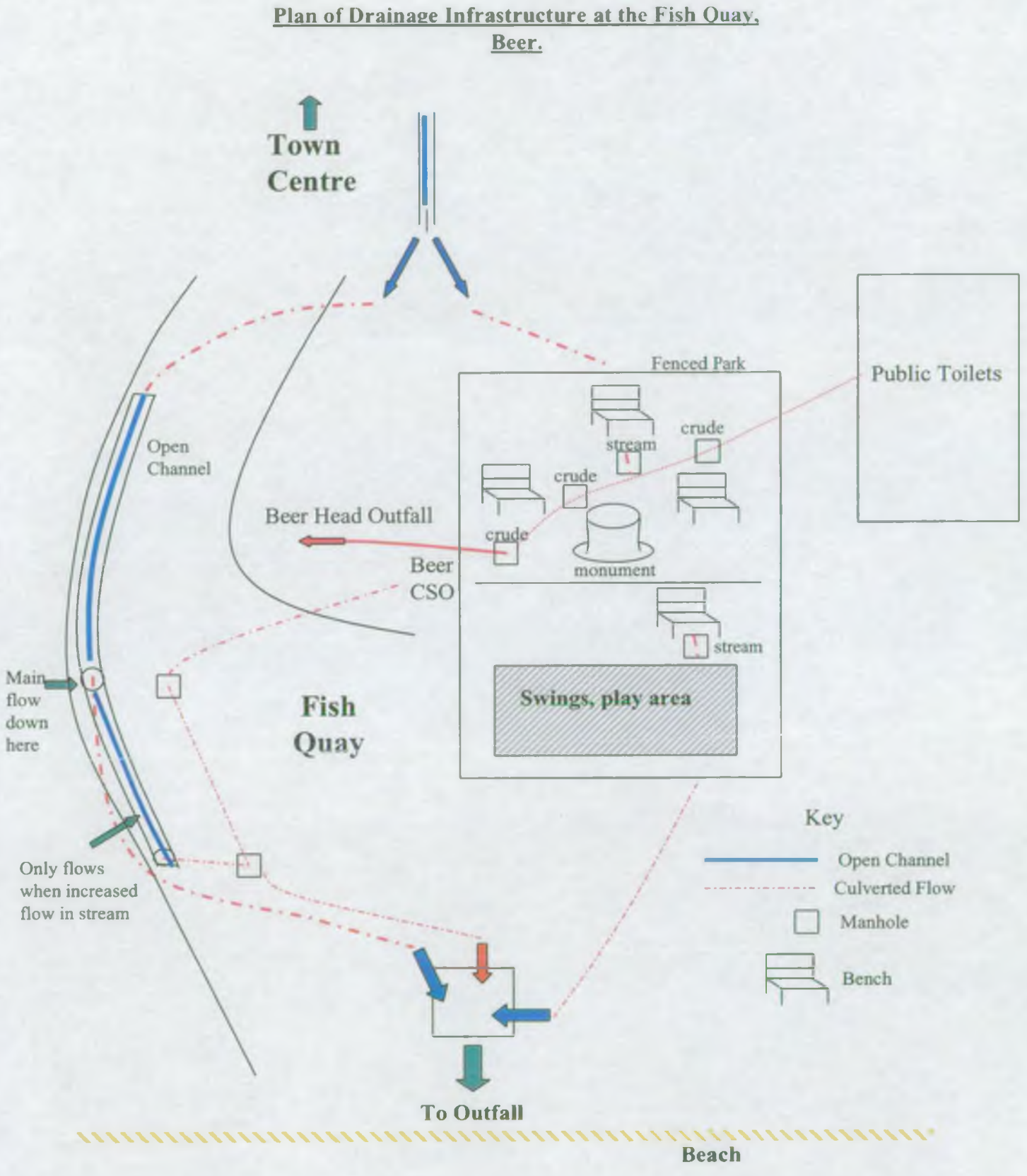

Plan of Drainage Infrastructure at the Fish Quay, Beer.
Town Centre
Fenced Park
Public Toilets
Open Channel
stream
crude
crude
crude
Beer Head Outfall
Beer CSO
monument
stream
Swings, play area
Main flow down here
Fish Quay
Only flows when increased flow in stream
Key
Open Channel
Culverted Flow
Manhole
Bench
To Outfall
Beach
Not to scale

Figure 4

Plate 1, showing agricultural runoff flowing down the B3174 into Beer town centre and Beer Stream.

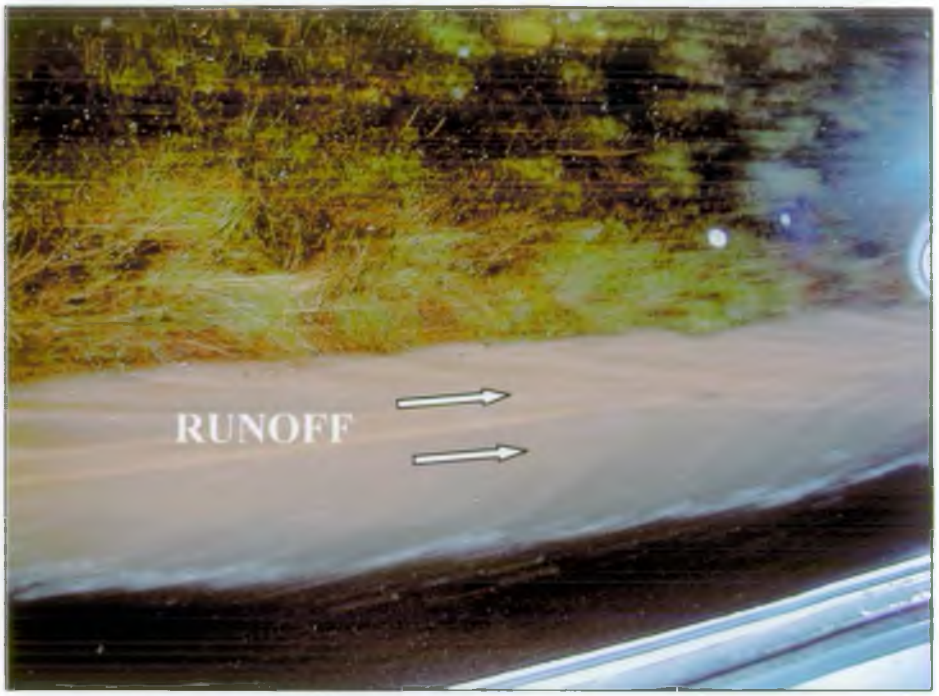


Plate 2, Showing runoff from Bovey Lane bridle path that combines with Beer Stream at source.

Figure 5

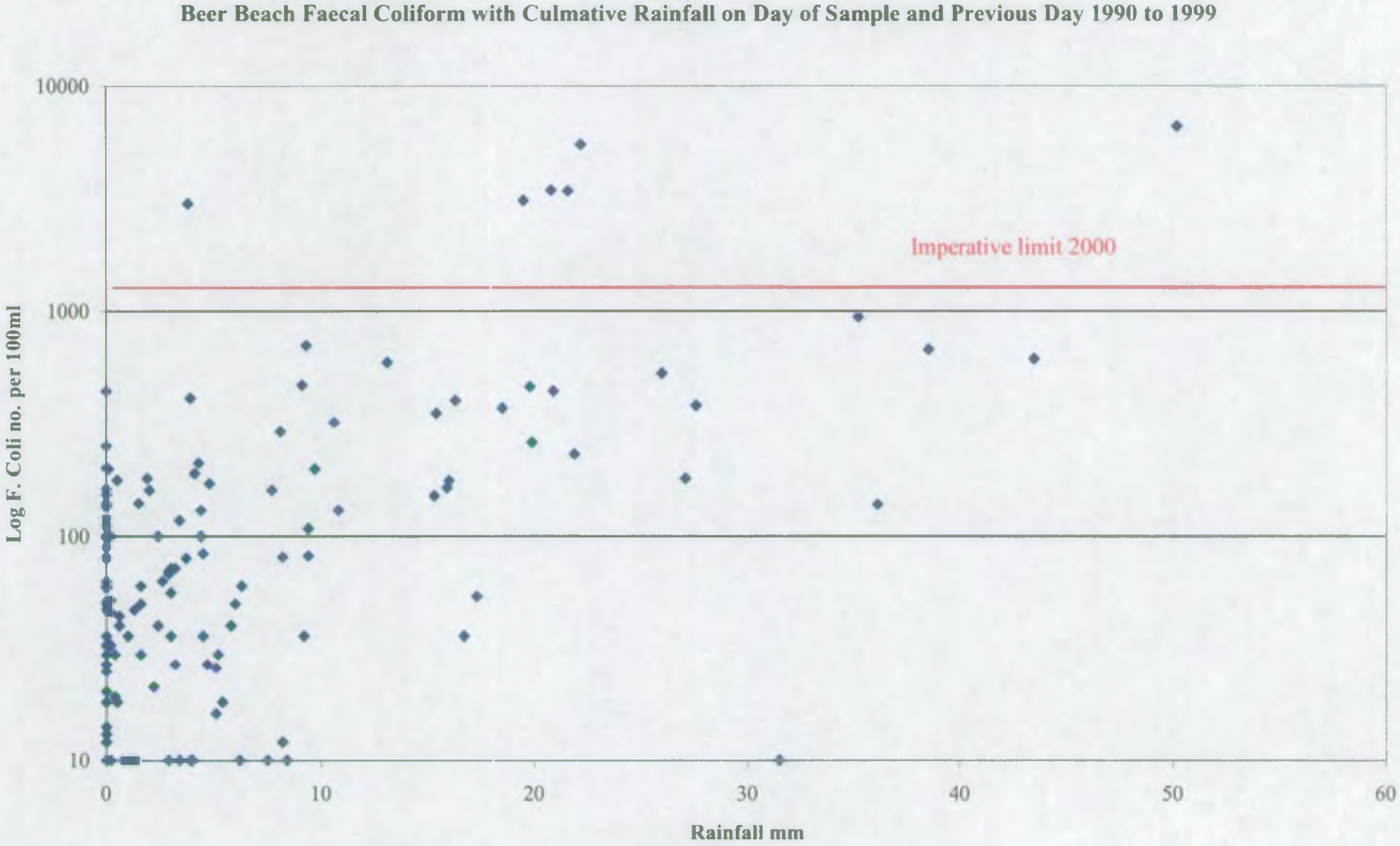

Beer Beach Faecal Coliform with Culmative Rainfall on Day of Sample and Previous Day 1990 to 1999
10000
1000
100
10
Log F. Coli no. per 100ml
Imperative limit 2000
0
10
20
30
40
50
60
Rainfall mm

Figure 6

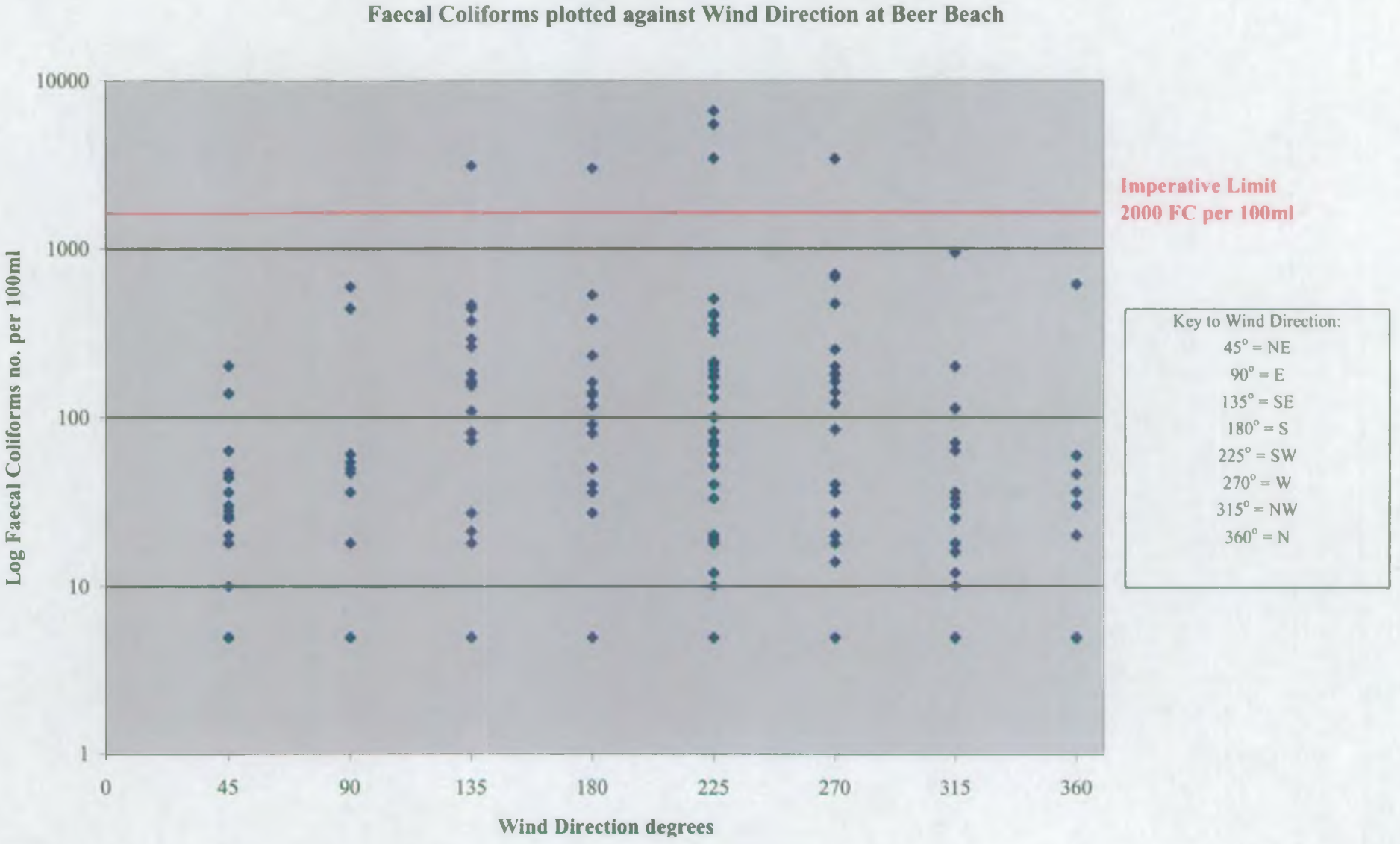

Faecal Coliforms plotted against Wind Direction at Beer Beach
Log Faecal Coliforms no. per 100ml
10000
1000
100
10
1
0
45
90
135
180
225
270
315
360
Wind Direction degrees
Imperative Limit
2000 FC per 100ml
Key to Wind Direction:
45° = NE
90° = E
135° = SE
180° = S
225° = SW
270° = W
315° = NW
360° = N

Figure 7

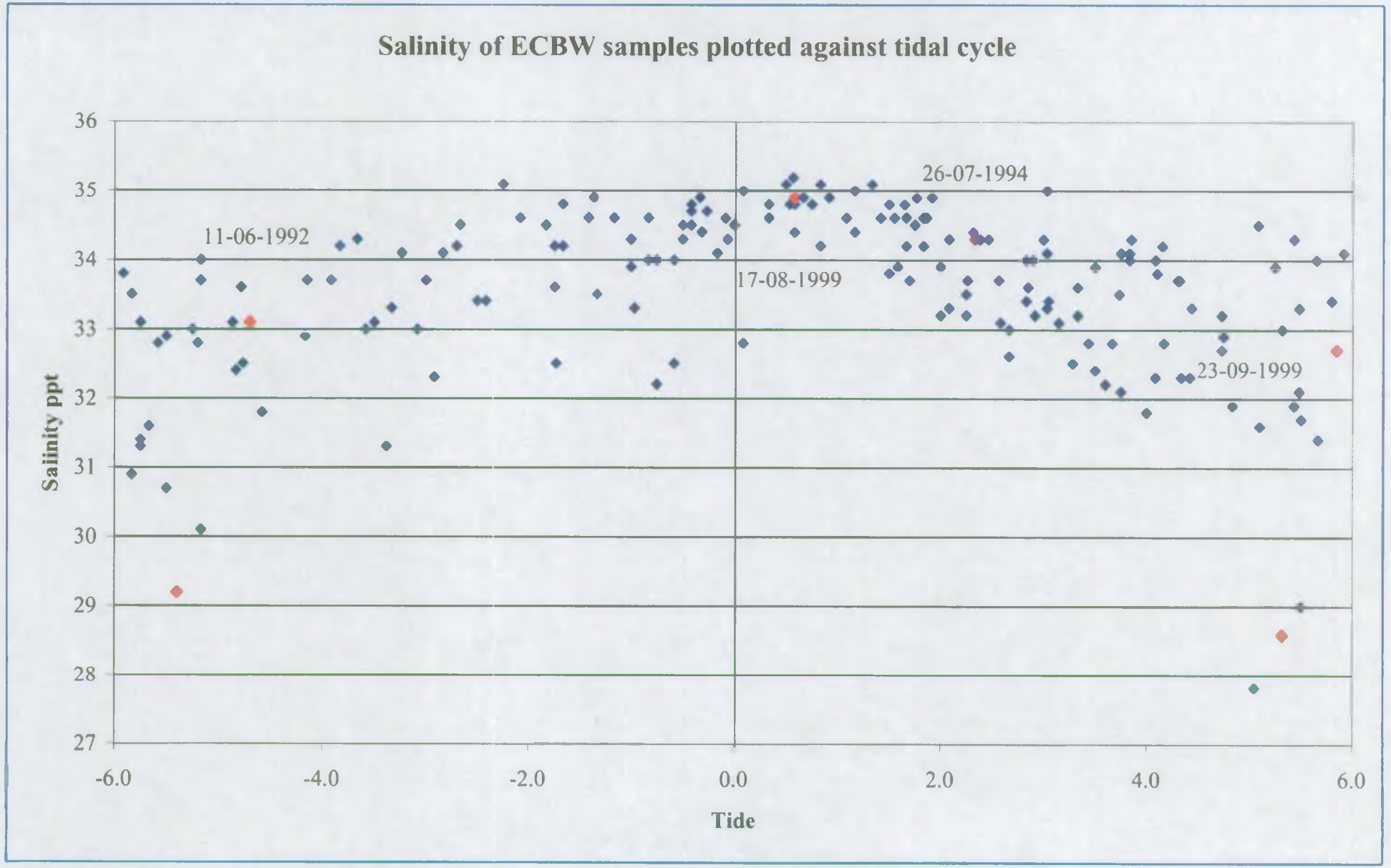

Salinity of ECBW samples plotted against tidal cycle
Salinity ppt
Tide
36
35
34
33
32
31
30
29
28
27
-6.0
-4.0
-2.0
0.0
2.0
4.0
6.0
11-06-1992
17-08-1999
26-07-1994
23-09-1999

Figure 8

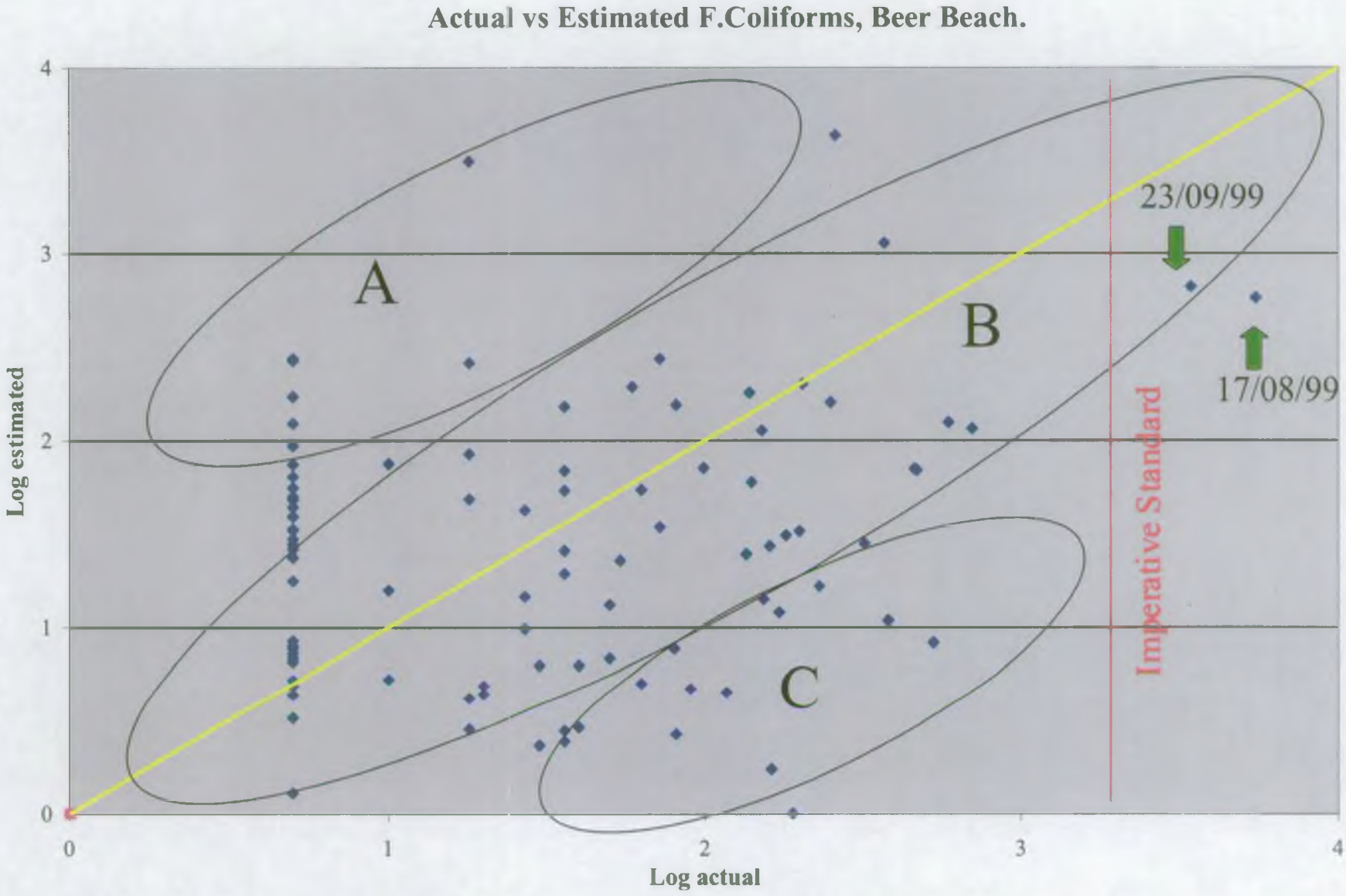
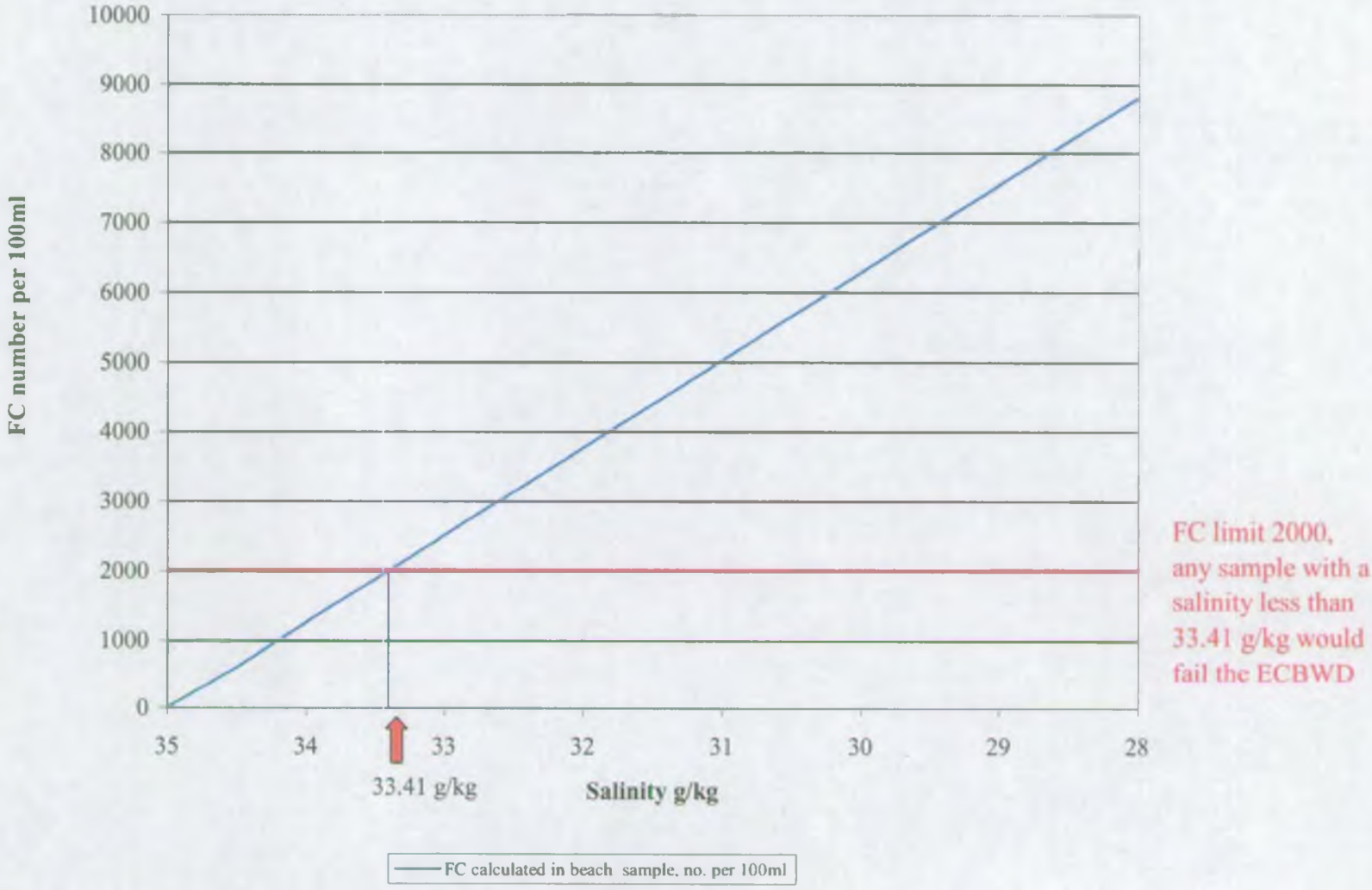

Actual vs Estimated F.Coliforms, Beer Beach.
Log estimated
Log actual
0
1
2
3
4
A
B
C
23/09/99
17/08/99
Imperative Standard

Figure 9

Chart showing salinity of Bathing water sample against FC numbers when Beer Stream has 44,000 FC per 100ml.



APPENDICES

Appendix 1

INTRODUCTION

The Bathing Water Directive (76/160/EEC) concerns the quality of bathing waters for the purpose of protecting public health and for reasons of amenity. The **mandatory** requirements of this Directive have been translated into UK legislation under provisions of the Water Resources Act 1991.

The Directive requires the Agency to take samples and analyse bathing waters in accordance with the Directive and to report the results annually to the Department of Environment, Trade and Regions (DETR), who then forward the results to the European Commission. Results of analysis are also reported throughout the bathing season to local authorities and private beach owners who can then display them at or near beaches.

DESIGNATED BATHING WATERS

For the 1997 bathing season 448 designated bathing waters were monitored in England and Wales.

In the South West Region 180 designated bathing waters were monitored during 1997, of these 60 were within Devon.

MONITORING

The recognised bathing season in England and Wales runs from 15 May to 30 September. Sampling commences on 1 May with 20 samples being collected at each designated beach by 30 September.

Samples are collected at different times of the day and at different states of the tide to provide a broad spectrum of water quality.

Sampling commences at 10.00 am and samples must be transported to the laboratory in a refrigerated van or cool-box within 6 hours of collection to maintain the integrity of the sample.

QUALITY STANDARDS

The **mandatory** coliform standards given in the Directive and used by DETR to assess compliance require there to be no more than 10,000 total coliforms per 100ml sample and no more than 2,000 faecal coliforms per 100ml sample. In order for a bathing water to comply with these **mandatory** standards, 95% of samples (i.e. 19 out of 20) must meet these standards.

In addition to the **mandatory** standards the Directive includes **guideline** standards which the Agency is required to have regard to when seeking water quality improvements. These **guideline** standards are one of the parameters used by the Tidy Britain Group (TBG) to issue the coveted Blue Flag to beach owners. The **guideline** standards used by TBG to assess compliance require there to be no more than 500 total coliforms per 100ml sample, no more than 100 faecal coliforms per 100ml sample and no more than 100 faecal streptococci per 100ml sample. In order for the bathing water to be considered for a Blue Flag 80% of samples (i.e. 16 out of 20) must meet the total and faecal coliform standards and 90% of samples (i.e. 18 out of 20) must meet the faecal streptococci standards.

FAILURES OF MANDATORY STANDARDS

The day following sampling the Environment Agency Laboratory notifies Environment Protection staff of "presumptive" failures of the **mandatory** standards. This enables field staff to investigate the cause of failure. It should be noted that this investigation takes place two full tidal cycles after sampling and in some cases the cause can remain undetected.

EC Bathing Waters Directive Summary of Standards

Compliance is generally assessed against the imperative (I) standards for the principal bacteriological parameters total and faecal coliforms. These standards are:

Total coliforms:	Max 10,000 per 100ml
Faecal coliforms:	Max 2,000 per 100ml

Bathing waters are allowed a five percent failure in any one year. This means that 19 samples in 20 have to meet the imperative standards for compliance to be achieved.

The principal guideline (G) standards, have to be achieved in 80 percent of samples i.e. 16/20 samples are:

Total coliforms:	Max 500 per 100ml
Faecal coliforms:	Max 100 per 100ml
Faecal streptococci:	Max 100 per 100ml (achieved in 90% of samples)

Environment Agency

Region South West (SW)

Sampling Point 21700 Beer Beach **NGR** SY23158910 **Updated** 29 March 2000

Year of Identification 1987

Category **Pre AMP1/2** 6 **End of 1997** 6 **End of 1998** 6 **End of 1999** 6 **Post AMP2** 6 **Post AMP3** 4

Compliance Record and Water Quality Summary

The table below includes the following abbreviations - FC: Faecal Coliforms, TC: Total Coliforms, FS: Faecal Streptococci

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Compliance	Guideline	Guideline	Imperative	Imperative	Fail	Imperative	Guideline	Imperative	Imperative	Fail
No. Samples	20	20	22	20	20	20	20	20	20	21
No. Fail FC Imperative	0	1	1	0	2	0	0	0	0	2
No. Fail TC Imperative	0	1	0	0	1	0	0	0	0	0
No. Fail FC Guideline	4	3	5	8	8	4	3	6	4	10
No. Fail TC Guideline	2	3	2	3	5	1	0	4	3	6
No. Fail FS Guideline	1	1	2	2	4	3	0	4	3	6
FC Geomean	30.19	39.31	36.27	48.93	81.03	39.23	21.72	52.18	34.02	71.55
TC Geomean	55.83	78.45	85.05	96.52	160.21	59.93	37.67	120.13	60.78	155.74
FS Geomean	15.07	19.44	11.86	22.72	44.94	22.67	16.26	24.87	21.08	40.38
FC Median	35	25	29	30	56	40	10	66	18	36
TC Median	68	65	67	125	157	65	41	140	54	97
FS Median	16	10	12	10	32	10	10	14	10	18

Risk of Future Non-Compliance with Imperative and Guideline Standards Based on Historical Data

Percentage Risk of Non-Compliance

	1990 to 1999 inclusive	1991 to 1999 inclusive	1992 to 1999 inclusive	1993 to 1999 inclusive	1994 to 1999 inclusive	1995 to 1999 inclusive	1996 to 1999 inclusive	1997 to 1999 inclusive
Imperative Faecal Coliforms						5.9		
Imperative Total Coliforms						0		

Risk Assessment Undertaken for Imperative Standards ☑

	1990 to 1999 inclusive	1991 to 1999 inclusive	1992 to 1999 inclusive	1993 to 1999 inclusive	1994 to 1999 inclusive	1995 to 1999 inclusive	1996 to 1999 inclusive	1997 to 1999 inclusive
Guideline Faecal Coliforms								
Guideline Total Coliforms								
Guideline Faecal Streptococci								

Risk Assessment Undertaken for Guideline Standards : ☐

Notes:

Actions Already Taken To Improve Water Quality

Water Company Improvements
Improvements to the Beer Combined Storm Overflow were completed in March 1999.

Other Actions
Beer stream has been monitored since 1995. Investigations in 1996 and 1997, following complaints, found a problem with an unconsented Combined Storm Overflow just above the Bathing Water, which has been improved (see above).

In 1999, one sample failure coincided with watercourse flooding. Outdoor pig farming in the Beer stream catchment meant that not only was there more runoff from these fields (owing to lack of vegetation) but also that the runoff was contaminated with bacteria from pig faeces. The pigs were subsequently moved to a new location away from the stream.

22/3/00

Factors Affecting Water Quality

WSC/PD	Name	Discharge Location	Comments
SWW	Beer Head Outfall	Beer Head	
SWW	Seaton (Southern)STW	River Axe	
SWW	Beer CSO	Beer Beach ECBW	
	River Axe	W of Seaton ECBW	
	Beer Stream	Beer Beach ECBW	
	Agricultural Run-off	Beer Beach ECBW	During heavy rainfall

The sources listed all contribute to elevated bacteriological levels. During heavy rainfall, Beer Stream, which is culverted under the beach to below the mean low water mark, can run across the foreshore about 100m from the Bathing Water monitoring point.

Abbreviations:
CSO - Combined Storm Overflow, ECBW - EC identified Bathing Water, MLWS - Mean Low Water Springs, O'F - Outfall, PD - Private Discharge, PS - Pumping Station, PSEO - PS Emergency Overflow, STW - Sewage Treatment Works, SWW - South West Water, WSC - Water Service Company, WxW - Wessex Water.

31/3/00

Planned Investigation

Some investigations are planned for 2000.

22/3/00

Planned Investment

A scheme for Beer is identified in the Asset Management Plan 3 to be completed by March 2002. The scheme requires secondary treatment.

20/3/00

Predicted Changes in Water Quality

This Bathing Water will remain at risk of failing 'Imperative' standards until the problems with bacterial contamination of the stream are resolved and the improvements are made to the Beer Head discharge.

22/3/00

DEVON AREA H&S SITE RISK ASSESSMENT

ver 1.1
14/02/00

TRADE / FARMS / INVESTIGATIONS / STW / FRESHWATER / MARINE

SITE: BEER, BEER STREAM & BEACH

CATCHMENT / NGR: 02A

Mobile phone reception: Good / Poor

Date of Assessment: 22-5-00

Name of Officer: S. HUNTER

URN:

CONSIDERATION (A) GENERAL	YES	NO	RISK H/M/L	ACTIONS REQUIRED
1. Do you need to notify site manager/ landowner of Agency presence?		✓		
2. Do you need to be accompanied by site staff?		✓		
3. Does task require more than one person?		✓		
4. Are you working outside daylight hours?		✓		
5. Do you need to employ Lone Worker procedures?		✓		
6. Is protective clothing required?	✓		L	Life jacket for sampling beach and stream gloves if contaminated returning to Sampler
7. Will seasonal factors affect site safety?	✓		L/M	If sea rough steep pebbly beach.

8. Are there dangers from the following	YES	NO	RISK H/M/L	
chemicals		✓		
biological hazard / infection from animals / pathogens	✓		L	If storm overflow operating / run off from agriculture - Pigs
explosive / noxious gases		✓		
inhalation of fumes/dust/asbestos		✓		
moving vehicles	✓		L	In town centre traffic.
machinery	✓		L	~~Work~~ Winches pull boats up beach be aware
falling objects		✓		
electricity sources		✓		
open tanks / lagoons / catch pits		✓		
ladders / steps / scaffolding		✓		

	YES	NO	RISK H/M/L	
9. Are overhead power supplies present?		✓		
10. Is site secure for equipment installation?		.		N/A

(B) VEHICLE ACCESS

	YES	NO	RISK H/M/L	
1. Is there safe vehicle access to site?	✓			
2. Can vehicles be parked/left safely?	✓			for short periods.

(C) FOOT ACCESS

	YES	NO	RISK H/M/L	
1. Is there safe foot access to the site?	✓			
2. Are there fences/ditches etc. to cross?		✓		

(D) BANK SITES

	YES	NO	RISK H/M/L	
1. Are banks steep or slippery?	✓		L	Beach not river
2. Might banks be undercut?				N/A
3. Is water deep/strong currents?				N/A

(E) CLIFF OR SIMILAR SITES

	YES	NO	RISK H/M/L	
1. Are there dangers from falling?		✓		
2. Is the terrain steep/slippery?		✓		
3. Might the cliff be overhanging?		✓		
4. Are ropes required?		✓		

(F) CONFINED SPACES

	YES	NO	RISK H/M/L	
1. Are confined spaces involved? IF *YES* YOU MUST COMPLETE THE CONFINED SPACE FORM HELD IN OFFICE		✓		

(G) BOAT WORK

	YES	NO	RISK H/M/L	
1. Is boat work involved? IF *YES* YOU MUST COMPLETE THE BOAT WORK FORM HELD IN OFFICE		✓		

(H) MANHOLES

	YES	NO	RISK H/M/L	
1. Is the area around the manhole safe?	✓		L	hinged manhole, triangle shape
2. Are bollards/cones required?		✓		
3. Can cover be lifted safely?	✓			
4. Are cover keys/other equipment needed?	✓			one large Key

(I) AGGRESSIVE BEHAVIOUR

	YES	NO	RISK H/M/L	
1. Are people likely to be aggressive?		✓		
2. Are guard dogs/farm dogs/other livestock a risk?		✓		

(J) OTHER

RISK H/M/L	

Appendix 4

Beer

TO: STUART HUNTER INVESTIGATIONS

FROM: CONSERVATION (DEVON AREA) JD HARPER

CODE: CONS

REF NR:

NGR100: SY NGRE: 225 NGRN: 895

SITE: BEER BEACH AND ENVIRONS AROUND BEER STREAM, EAST DEVON

DESCRIPTION: INVESTIGATION INTO BATHING BEACH FAILURE

DESIGNATION: BEER QUARRIES cSAC, / SSSI, EAST DEVON HERITAGE COAST / AONB, SIDMOUTH TO WEST BAY cSAC / Sidmouth to Beer Coast SSSI

LAND USE:

COMMENTS: Your area of investigation includes the followiing conservation designations:

BEER QUARRIES cSAC / SSSI (Bat interest)
EAST DEVON HERITAGE COAST / AONB (Landscape designations)
SIDMOUTH TO WEST BAY cSAC (which includes Sidmouth to Beer Coast SSSI) - (vegetated sea cliffs, wooded slopes and drift-line vegetation)
Bovey Lane Quarries County Wildlife Site (Unimproved calcareous grassland) and Quarry Lane Special Road Verge (Pyrimidal Orchids).

These sites are shown on the attached map.

Obviously, we would be concerned if any of your investigations pick up potential harmful impacts to any of these sites, or especially if originating from any of these sites.

Particular caution should be adopted when undertaking investigations within the vicinity of pSACs and consultation will be required with English Nature, should access to these sites be required. Any activities will require an assessment of significant effect before investigations proceed.

I hope the foregoing doesn't sound too horrendous, but I have to draw your attention to our responsibilities. It is difficult to comment in detail at this stage before knowing exactly how your investigation is to proceed.

CONSULT:

REPLY BY:

DATE: RESPONSE BY: JMH

Beer Beach failure